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ABSTRACT

The Environmental Issues Test (EIT) is an instrument designed to assess moral and ethical reasoning within a scientific or technological context. It is comprised of five dilemma stories each of which highlights an environmental issue and the moral conflicts inherent in that issue. Following each dilemma story is a series of 12 issues statements, each keyed to a specific moral reasoning stage as defined by Kohlberg. Respondents are asked to assign a priority rating to each statement in terms of its relative degree of importance in making a particular decision. The evaluation of the EIT and the development of a similar test for younger students is described. (BB)

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THE SOCIO-SCIENTIFIC REASONING MODEL:

INSTRUMENTS FOR EVALUATION

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THE SOCIO-SCIENTIFIC REASONING MODEL

INSTRUMENTS FOR EVALUATION

I. Introduction

An integral component of the socio-scientific reasoning model formulated by the Institute for Science, Technology, Social Science Education addresses the development of moral-ethical reasoning. If, as we contend, the basic philosophy and educational implications of Piaget, Kohlberg and Selman are appropriate for science education, the questions now become: 1) How do we determine the maturity level of our students; 2) How do we determine the appropriate strategies and activities for our students, and 3) How do we determine that our efforts and programs are successful?

Moral reasoning levels have been typically assessed by Kohlberg and his colleagues using the moral judgment interview (Kohlberg, 1963). However, this is a laborious and time-consuming task since it is a clinical interview on a one-to-one basis, requiring highly trained interviewers with an in-depth knowledge of the scoring protocol. An alternative is James Rest's Defining Issues Test (an objective paper and pencil test) (Rest, 1973), based on Kohlberg's dilemma stories. This instrument taps an individual's preference for a particular mode of reasoning on moral issues. However, the specificity of the test as it relates to moral reasoning within a scientific context raises certain methodological concerns. For example, in explaining horizontal decalage in the development of logical reasoning, Piaget observes that people tend to reason at higher levels in those areas in which they have greater knowledge or experience (Piaget, 1972). This suggests that the context and issues about which one reasons can influence the maturity level of the response.

That horizontal decalage is also evident in the moral-ethical reasoning sphere which was elucidated by Iozzi in a study conducted in 1975 and 1976 (Iozzi, 1976). In his studies the responses to the Rest Defining Issues Test (DIT) were compared to the Iozzi instrument, the Environmental Issues Test (EIT). The EIT differed from the Rest DIT only in that the dilemma story is changed. The issue statements, which respondents evaluate, remained essentially identical. The study revealed that people reason at different moral levels on moral issues set in a different context. Environmental science majors at a large eastern university, in contrast to students at the same school majoring in the humanities, received higher scores on the EIT than on the Rest DIT. That is, they selected higher stage issue statements when they responded to the dilemma story based on an environmental issue and selected fewer higher stage statements on dilemma stories based on general social issues. The study attributed this difference to the findings that not only were environmental science majors more familiar with environmental issues, they were significantly more knowledgeable, possessed greater interest in, concern for, and commitment to, environmental causes than were the humanities majors. On the other hand, the humanities majors did not achieve significantly different scores on the DIT and EIT.

II. THE EIT TEST

The EIT is comprised of five dilemma stories each of which highlights an environmental issue and the moral conflicts inherent in that issue. Following each dilemma story is a series of 12 issue statements, each keyed to a specific moral reasoning stage as defined by Kohlberg. Respondents are asked to assign a priority rating (from "greatest" to "no" importance, a four-category scale) to each statement in terms of its relative degree of importance

in making a particular decision. Based on this rating, they then select the four most important in rank order. Each dilemma is scored in terms of the moral reasoning level of the four most important statements selected with relative weighting given to each rank. An individual's reasoning level is obtained by adding the scores on all the dilemma stories tested.

Validation of the EIT

Is the EIT, therefore, a valid instrument to assess moral judgment levels? While the EIT deals with moral issues cast in an environmental context and because of its similarity to Rest's Defining Issues Test, the EIT can be said to have "face validity." However, it is also important to determine the construct validity of the instrument, that is, does the instrument provide a measurement of the psychological construct, moral judgment? (Cronback and Meelk, 1955; Rest, 1976). Based on the procedures established by Rest, the validity of the EIT was determined by the following criteria: (Iozzi, 1976)

1. Test-retest stability
2. Age trends
3. Correlation with attitudes on current environmental issues (Maloney, 1971; Maloney and Ward, 1973)
4. Correlation with comprehension of moral concepts.
5. Correlation with existing moral judgment measures (Rest, 1973).

Applicability of the EIT

Given that tests of construct validity support the contention that the EIT measures levels of moral/ethical judgment for moral issues set in an environmental context, we have used the EIT to assess the effectiveness of our program materials which present environmental issues. The advantage of this test lies in the fact that it provides baseline information quickly and easily.

Moreover, its method of scoring permits investigators to detect small increments of change. This is especially important for short-term interventions where one cannot expect a full stage shift from one stage to the next, because stage changes occur gradually over periods of years. Change, as detected with the EIT, is based on what is termed the "P" score. The "P" score is interpreted as the relative importance, expressed as a percentage, an individual gives to morally principled considerations in making moral judgments. This score is obtained as follows:

$$\text{"P" score} = \frac{\text{score of principled statements selected}}{\text{score of total possible principled statements}} \times 100$$

This scoring procedure, in contrast to stage scoring, allows for detection of slight changes within a stage.

In addition, baseline data on secondary school students on through adulthood can provide useful information to guide the development of educational programs and materials which address the moral/ethical implications of decision making in a scientific technological context. That is, curriculum developers now have a method to determine those moral/ethical issues and concepts appropriate and understandable to the target audience. For instance, issues that deal with the right of scientists to publish research results without censorship versus the interest of national security may be more appropriate for older students. Whereas, the issue question concerning the rules of laboratory safety and the breaking of the rule may be more appropriate for younger students. Knowing the range of levels within an age grouping, it is also possible to design those activities and teaching strategies that best match students' capabilities and environmental perspectives. Concepts may need to be presented in a more interactive and concrete manner for younger students while more mature students can, with greater ease, comprehend concepts presented through written materials. All important is knowing the reasoning approach an individual might

apply to a given issue or concept.

III. THE DEVELOPMENT OF NEW TESTS

The Scientific Issues Test

While the basic moral/ethical issues addressed in the EIT and the DIT are essentially the same (i.e., issues concerning the "quality of life," individual rights, duties and obligations, etc.), we have found that the level of reasoning employed in resolving dilemmas in the different contexts tend to vary as a function of experience. If we are to more adequately determine the effects of experience with programs and curriculum materials dealing with the dilemma situations arising from scientific/technological activities and applications, we have need for tests which more closely parallel that topic of concern. That is not to say that the other tests are inappropriate for identifying an individual's reasoning level, but that more precise information can be obtained about reasoning within a specific area if the instruments focus on related issues and topics. Such an instrument will further assist in testing our contention that exposure to specific experiences can stimulate a person's interest and provoke him/her to think through an issue in greater depth, and subsequently apply higher reasoning levels in resolving the conflict situation.

For example, in our bioethics module we addressed ethical issues such as the use of human subjects in drug experimentation, the selection of patients for organ transplantation, the use of extraordinary life-sustaining measures, etc. Issues of this nature may arouse higher levels of emotionality because each one of us can readily personalize and relate to that human situation. Therefore, resultant behavioral changes after exposure to that module may not

be detected with a high level of sensitivity using the EIT.

Clearly, there is a need for a test employing dilemma stories that parallel the subject area topics. We, at the Institute, are designing a Scientific Issues Test, following the EIT and DIT format. This test, with a focus on the issues that interface science, technology and society, will be appropriate for students from the ninth grade into adulthood, and should prove useful for evaluating projects and programs which require a measure of scientific values not addressed in the EIT.

A SIT Designed for the Lower Grades - The Junior SIT

A number of difficulties have been encountered using the EIT with younger students below the ninth grade. Firstly, the test format requiring students to assign priorities to the twelve issue statements and rank order the four most important, is, for the most part, an unfamiliar task. Students seem to find greatest difficulty translating the priority rating into useful information to help them select and rank order the four most important considerations.

Secondly, the large number of issue statements appear to tax the attention span of younger students, and as a result they have difficulty making their selections. Fortunately, the scoring procedure permits identification of those students who make random selections. Applying this screening process, we have had to discard 20% to 30% of the tests. This, of course, significantly reduces our data base. In addition, some students complete the prioritizing section but leave out the final ranking, the section which is scored.

Thirdly, a higher proportion of the issue statements are keyed for stages 4, 5 and 6 and do not measure with great sensitivity the reasoning level of younger students who may be reasoning at stages 2 and 3. Also, these statements, to some degree, are written in language somewhat difficult for younger

students to understand. Hence, they fail to correctly interpret the meaning of the statements, even though it is possible that they have some understanding or preference for those concepts.

A more appropriate test for the younger age group should 1) contain a greater number of statements keyed to a less sophisticated level of reasoning, 2) be written in simpler language, 3) have a less complex testing procedure to follow, and 4) have a more simplified and manageable method of scoring (i.e., a test which can be machined scored rather than handscored, which is the case with the EIT and DIT). The Junior version of the SIT in development at the Institute will fulfill all the above conditions.

In the Junior SIT the dilemma story format will be retained, but the answers will be selected from among a series of multiple choice answers, eliminating the cumbersome and often confusing process of prioritizing and ranking. The development design which we will use is summarized below:

Dilemma Story Selection: A number of dilemma stories will be tested, using a 9-year to 15-year-old population as subjects. Employing a series of probe questions, responses will be elicited through clinical interviews. Analysis of the responses will reveal those dilemma stories which are most relevant and comprehensible to this age group. Based on these results a battery of dilemma stories will be selected.

Identification of Typical Responses: A larger sample population will be interviewed with the dilemmas selected following Kohlberg's moral judgment interview protocol (Kohlberg, et al., 1978). Each interview will be taped recorded. Evaluators trained in scoring Kohlberg's moral judgment interview will 1) identify the typical responses and 2) stage-type those responses. Inter-rater reliability tests will be performed at that time.

Construct Multiple Choice Test: The basic structure of the Junior SIT will be a series of dilemma stories, each followed by a set of questions. Answers to the questions will be selected from among four possible choices. The questions will be based on the probe questions used in the clinical interview. Respondents will select from among the possible choices the one they believe best resolves the question. Each of these answers is derived from the set of typical responses previously identified and stage-typed.

The multiple choice format of this test will facilitate test taking. Testing time will be reduced, test instructions will be simplified, and the test can be easily and quickly scored. The score obtained will reflect the dominant moral reasoning stage an individual employs to identify what he/she holds to be the most important considerations in making judgments. Also, since each of the response choices is stage-typed, it is therefore possible to obtain scores for each of the stages. By examining the component scores, we can obtain a more definitive picture of a person's reasoning level as well as detect the subtle changes that occur between levels following intervention studies.

IV. CONCLUSIONS

We are not aware of any other instruments presently available which are designed to assess moral/ethical reasoning within a scientific technological context. This gap can be met with the EIT, which addresses science and technology issues within an environmental context, and the SIT and the Junior SIT, which are currently being developed. The last two instruments which will cover a wider range of issues interfacing science, technology and society, we believe, can serve as important research and evaluation tools. The SIT will be appropriate for guiding curriculum development efforts and evaluation of those

programs and strategies at the senior high school level and beyond. The Junior-SIT will be useful at the upper elementary and middle school grades.

Knowledge acquisition is for the most part easily measured. However, if the moral/ethical dimension is an equally important factor in the education of a responsible and contributing citizenry, we need to better understand the developmental process of this thought component, and provide those experiences that will facilitate continuous upward growth.

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